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UTILIZATION OF THE SOILS IN THE GILROY REGION

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INTRODUCTION

Care must be taken to observe the winds
And changing skies, what modes and habits be
The region's heritage, what gifts each place
Bears or denies. These acres favor corn
In yonder vines grow better; elsewhere spring
Fruit orchards and a wealth of unsown green.

—*Virgil.*

It was recognized early in agricultural history that individual crops do not grow equally well in all environments—that certain plants require definite climatic, soil, and other conditions for their maximum development.

Also, in regions containing diverse soils and growing diverse crops, it has been observed that under continued agricultural development there is a tendency, due to economic factors, for crops to be planted and to persist in soils where they are profitable and to disappear from soils where they are not. Eventually, the crops of a region will become aligned with the soils on which they are economically best suited.

In the south-central portion of the Santa Clara Valley a relatively long continued development of intensive agriculture has occurred, in which soil variation has been the chief factor in crop-distribution. The trees, vines, and other crops in this region are located appar-

ently with regard to these variations. (Figure 1.) So marked is this tendency that the crop and soil boundaries frequently coincide.

This study deals with the extent of the correlation of these crops and soil types and, in this region, the proportion of each crop on each soil has been assumed to be a measure of the relative suitability of that crop for that soil.

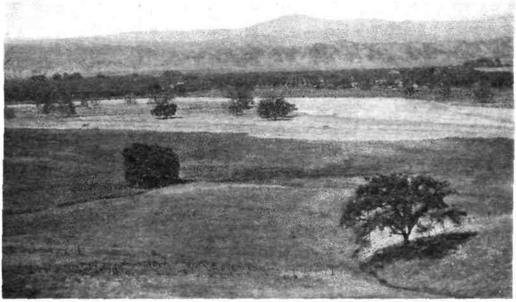

Fig. 1. Looking westerly across Santa Clara Valley near Coyote. Grazing on hills in foreground; grain for hay on the coarse soils along the Coyote Creek; orchards (mainly French prunes) on the medium-textured Yolo soils in middle distance; and sugar beets, truck and seed crops on the heavy Dublin soils at base of the distant hills.

Description of the Gilroy Region

Location.—This study covers that part of the Santa Clara Valley which extends from the vicinity of Coyote southeasterly to Gilroy and from the lower slopes of the Diablo Range on the east to the foothills of the Santa Cruz Mountains on the west. As indicated in figure 2, this region is roughly rectangular in shape with a length of twenty miles and an average width of three.

Topography and Drainage.—The foothills of the mountain ranges on the east and west are sharply defined, emphasizing the relatively flat and smooth valley plain which slopes with a gentle gradient from an elevation of about 450 feet above sea-level at the mouth of the Coyote Creek canyon to approximately 250 feet at Coyote and 200 feet at Gilroy. Near Morgan Hill an inconspicuous drainage divide is formed across the valley by the alluvial fan of Coyote Creek, which is the major stream in the northern drainage basin. Llagas Creek, with its

tributaries, carries the southern drainage into Monterey Bay, by way of the Pajaro River. Neither topography nor drainage have had a determining influence on the distribution of crops in this region.

Climate.—The climate of the Gilroy Region is characterized by a long, practically rainless summer season and a rainy winter period. The U. S. Weather Bureau reports the mean annual temperature at Gilroy as 58.4° F. and the average annual precipitation as 20.09 inches.

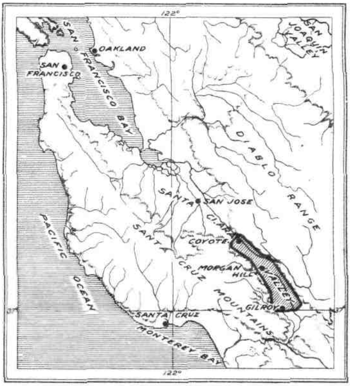

Fig. 2. Sketch map of the Santa Clara Valley and vicinity showing the location of the Gilroy Region.

There is little variation in climate between different points in the region; Coyote, on the north, has temperature and rainfall similar to those for Gilroy in the southern part, while Morgan Hill with a similar temperature has a slightly higher precipitation, probably about 22 inches. From an agricultural standpoint, this difference in rainfall is of very minor importance, as irrigation is commonly practiced throughout the region.

Acting as barriers, the Santa Cruz Mountains on the west and the Diablo Range on the east protect the region from the cold ocean fogs of the coast and the desiccating heat of the interior valley. With this protection from either extreme the climate of this portion of the Santa Clara Valley is a moderate one, conducive to the profitable production of a wide range of crops.

Transportation Facilities.—The coast route of the Southern Pacific Company traverses the length of the Gilroy Region and supplies shipping facilities to all coast and eastern markets. No point in the region is more than four miles from a station on this railroad. The Coast Highway (a concrete-paved main highway connecting San Francisco and Los Angeles) parallels the railroad and, with the network of connecting roads, provides an adequate system for vehicular traffic.

Soils.—Detailed descriptions of the soils of this region may be found in the Soil Survey of the Gilroy, California, Area (Advance Sheets, Field Operations of the U. S. Bureau of Soils, 1923), the Reconnoissance Soil Survey of the San Francisco Bay Region, California (Field Operations of the U. S. Bureau of Soils, 1914), and other California surveys. For the purpose of this paper, brief references to their major characteristics will suffice.

Three main classes of soils are represented in the Gilroy Region; (*a*) Recent alluvial, (*b*) Old transported, and (*c*) Residual. They are formed of material originating in the rocks of the coast mountain ranges, which consist principally of sandstones and shales with minor amounts of chert and numerous intrusions of basic igneous character. On the basis of their general physical characteristics, these soils may be arranged in seven sub-groups, as follows:

(1) Recent alluvial soils of light to *medium texture*, deposited under conditions of adequate drainage. These are deep, friable, well-drained soils of medium to high fertility and include the light to medium-textured types of the Yolo and Vina series.

(2) Recent alluvial soils of *heavy texture*, generally deposited under conditions of restricted drainage. Characteristically, these have an adobe structure, a very high water-holding capacity, and are of high fertility. This sub-group includes the heavy-textured types of the Yolo, Dublin and Conejo series.

(3) Recent alluvial soils which are being deposited at a sufficiently slow rate to permit progressive weathering, causing *heavier subsoils*, which tend to retard the movement of water and limit the development of root systems. In this sub-group are the Honcut and Laguna series of soils.

(4) Old transported soils of gravelly character having relatively *permeable subsoils*. These soils possess a lower content of organic matter and are of somewhat lower fertility than the recent alluvial soils. This sub-group includes the soils of the Pleasanton and Corning series.

(5) Old transported soils having non-calcareous, heavy-textured, compact, and relatively *impervious subsoils,* which limit the root-system development and impede the movement of water. This includes the soils of the Rincon, Pinole, and San Ysidro series.

(6) Old transported soils having medium to heavy-textured surface soils and slightly compact, *calcareous subsoils.* This subgroup is of minor importance in the Gilroy Region and includes the limited areas of soils belonging in the Antioch and Montezuma series.

(7) Residual soils; formed in place by the weathering of underlying bedrock. Their typically shallow depth and hilly topography makes them of minor importance. In this sub-group are the soils of the Aiken, Olympic, Arnold, and Climax series.

Fig. 3. View across valley between Morgan Hill and Madrone, showing character and extent of agricultural development.

Agriculture.—Gaspar de Portolá, who discovered the valley in 1769, described it as "a beautiful park-like region spotted with magnificent oaks and abounding in wild game." The earliest permanent settlements were made during the first quarter of the nineteenth century and until California came under the jurisdiction of the United States the chief activity was the raising of cattle. Grain, principally wheat, was the first major crop to be planted, although attention soon was directed to dairies, orchards, and vineyards. In 1870, the coast route of the Southern Pacific Company was constructed through the valley, giving a further impetus to agricultural development, which forced the cattle interests to the bordering foothill districts. Since 1880 the planting of grains and other extensive crops

has been rapidly replaced by fruit growing, a transition which has caused this region to be at the present time one of the most highly developed agricultural districts of the state. (Figure 3.)

Approximately 85 per cent of the Gilroy Region may be classed as tillable land, of which about 80 per cent is cropped or otherwise developed. Orchards (predominantly of the French prune) and vineyards comprise the greater part of the plantings. Irrigation is extensively practiced, nearly 90 per cent of the orchards and about two-thirds of the entire planted area being irrigated. Water for this purpose generally is pumped from wells.

Crop-Soil Measurements and Correlations

Crop and soil data were collected during three growing seasons, 1923, 1924 and 1925. By means of a special survey in July, 1924, the crops were identified, measured and plotted on a suitable base map. This was superposed on a map of the soils (from the Gilroy soil survey) and a combined soil-crop map constructed (plate 1). The individual and the aggregate acreages of each class of crop on each type of soil were determined from this map and tabulated. (Plate 2.)

Of the 47,045.1 acres covered by this study, these data show that 39,747.0 acres are tillable and that 26,375.8 acres of these are planted to crops of various classes. Planting does not occur on all of the types and phases of soil in like proportion; Climax clay adobe (with an extent of 562.3 acres) is entirely unplanted, while approximately 91 per cent of the Dublin silty clay loam (1751.8 acres in extent) is planted to crops.

Smaller differences in relative development occur on the three most important and extensive soil types. The Yolo silt loam (with a total area of 4240.8 acres) has 86 per cent of its area planted to crops, the Pleasanton gravelly loam (with 7257.0 acres) has 82 per cent planted to crops, and the Pinole silt loam (5604.9 acres in extent) has 78 per cent of its area planted.

Planted, unplanted, and total acreages for each of the thirty-one soil types and phases and the three miscellaneous classes of materials recognized in the Gilroy Region are given in table 1.

The crops of the region are divided into twenty-two classes, eight of which are separated into "bearing" and "non-bearing." In most cases the mixed, or interplanted, crop areas are distinguished according to their components. The French prune is the most extensively planted crop, occupying nearly 17,000 acres, as compared to about

TABLE 1

PLANTED AND UNPLANTED ACREAGES ON SOIL TYPES

Soil type, or phase	Planted area, in acres	Unplanted area, in acres	Total area, in acres
Subgroup (1):			
Yolo gravelly loam	991.1	460.3	1451.4
Yolo fine sandy loam	330.0	726.5	1056.5
Yolo silt loam	3671.1	569.7	4240.8
Yolo silt loam, shallow phase	1502.8	510.0	2012.8
Yolo silty clay loam	1637.2	227.6	1864.8
Vina gravelly loam	574.5	407.9	982.4
Vina silt loam	15.1	15.4	30.5
ubgroup (2):			
Yolo clay adobe	283.8	79.7	363.5
Dublin silty clay loam	1584.6	167.2	1751.8
Dublin silty clay loam, gravelly phase	205.1	118.0	323.1
Dublin clay adobe	979.2	1014.3	1993.5
Conejo clay loam	581.9	523.9	1105.8
Conejo clay adobe	1235.6	1937.0	3172.6
Subgroup (3):			
Honcut clay loam	150.4	32.4	182.8
Honcut clay loam, gravelly phase	84.7	58.1	142.8
Laguna fine sandy loam	194.6	82.3	276.9
Laguna loam	40.8	85.3	126.1
Subgroup (4):			
Corning loam	93.3	56.4	149.7
Pleasanton gravelly loam	5994.3	1262.7	7257.0
Subgroup (5):			
Pinole silt loam	4420.5	1184.4	5604.9
Pinole silt loam, rolling phase	240.6	250.3	490.9
San Ysidro silt loam	820.5	112.2	932.7
Rincon loam	15.5	64.4	79.9
Rincon loam, rolling phase	84.7	188.9	273.6
Subgroup (6):			
Antioch clay loam	42.3	722.3	764.6
Montezuma clay adobe	12.8	582.8	595.6
Subgroup (7):			
Arnold loam	174.1	264.4	438.5
Aiken gravelly clay loam	241.6	264.9	506.5
Olympic gravelly clay loam	130.5	556.8	687.3
Olympic clay adobe	43.4	282.8	326.2
Climax clay adobe	....	562.3	562.3
Total, soil types	26,375.8	13,371.2	39,747.0
Miscellaneous:			
Riverwash	....	66.7	66.7
Rough broken land	4.2	498.9	503.1
Rough mountainous land	79.5	6648.8	6728.3
Total, miscellaneous	83.7	7214.4	7298.1
Grand total	26,459.5	20,585.6	47.045.1

4500 acres of grapes, more than 1000 acres each of Sugar prunes, apricots, alfalfa, truck and seeds, and about 400 acres of pears. The other crops, with few exceptions, are of minor significance in this study and vary in extent between 12 and 700 acres.

The different crop-classes in the Gilroy Region and the extent of their pure, mixed and total planted acreages are shown in table 2.

TABLE 2

PURE, MIXED AND TOTAL PLANTED AREAS OF EACH CROP CLASS

Crop	Pure planting, in acres	Mixed planting, in acres	Total planting, in acres
French prunes	13,533.5	3,079.8	16,613.3
Sugar prunes	1,161.7	695.4	1,857.1
Apricots	1,197.5	204.5	1,402.0
Peaches	396.9	231.8	628.7
Pears	220.6	188.5	409.1
Cherries	5.5	18.4	23.9
Apples	13.0	....	13.0
Figs	....	13.0	13.0
Walnuts	99.8	541.7	641.5
Almonds	75.6	107.9	183.5
Mixed orchard	220.3	7.2	227.5
Grapes	2,309.7	2,101.2	4,410.9
Alfalfa	1,037.8	10.5	1,048.3
Truck or seeds	904.6	123.7	1,028.3
Sugar beets	629.2	....	629.2
Tomatoes	393.6	318.1	711.7
Corn or sorghum	155.0	291.0	446.0
Strawberries	51.1	21.0	72.1
Bushberries	19.0	8.0	27.0
Myrobalan seedlings	61.2	....	61.2
Eucalyptus planting	34.8	....	34.8
Nursery stock	12.0	....	12.0
Total acreage	22,532.4	7,961.7*	30,494.1*

* The net area of mixed planting is 3926.7 acres and the net total planting is 26,459.1 acres, there being a duplication of 4035.0 acres in the mixed planting which appears in these totals.

Although some of the crops in this region are grown on a large number of soil types, a very noticeable relationship exists between the more extensive crops and soils. This is more obvious if comparisons are made on the basis of the proportion of the planted area of each soil which is occupied by the crop.

The French Prune.—The most extensively planted crop in the Gilroy Region is the French prune, 16,613.3 acres being occupied by

this fruit either in uniform stand or interplanted with other crops.* Cultural methods are simple and chiefly featured by irrigation, clean cultivation, and light pruning. Although a green cover crop is frequently grown, applications of commercial fertilizers are extremely rare. *The chief rootstock used for the French prune is the myrobalan.*

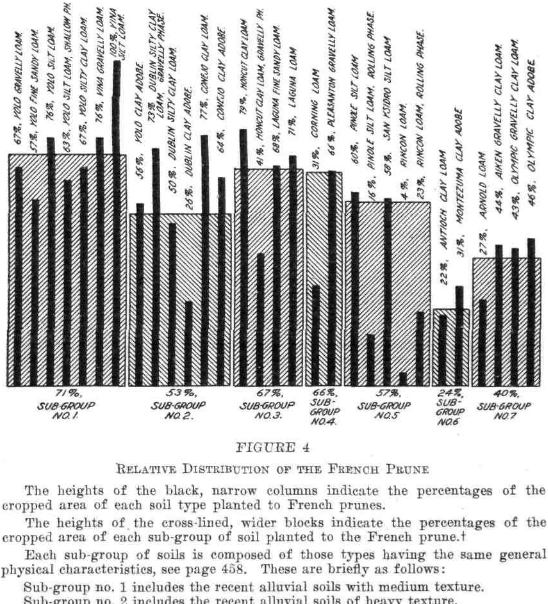

FIGURE 4

RELATIVE DISTRIBUTION OF THE FRENCH PRUNE

The heights of the black, narrow columns indicate the percentages of the cropped area of each soil type planted to French prunes.

The heights of the cross-lined, wider blocks indicate the percentages of the cropped area of each sub-group of soil planted to the French prune.†

Each sub-group of soils is composed of those types having the same general physical characteristics, see page 458. These are briefly as follows:

Sub-group no. 1 includes the recent alluvial soils with medium texture.
Sub-group no. 2 includes the recent alluvial soils of heavy texture.
Sub-group no. 3 includes the recent alluvial soils with heavy subsoils.
Sub-group no. 4 includes the old transported soils with permeable subsoils.
Sub-group no. 5 includes the old transported soils with impervious subsoils.
Sub-group no. 6 includes the old transported soils with calcareous subsoils.
Sub-group no. 7 includes the residual soils.

*Included in this crop class, but having no appreciable influence on the major relationships, are very minor acreages of Imperial, Robe de Sergeant, Silver, Standard and Italian prunes.

† In calculating the percentages for the sub-groups only those soil types having a part of their acreage planted to this crop were included.

For more than half a century the French prune has been grown commercially in this region. The total acreage has shown a steady increase during this period, although many of the earlier orchards in unsuitable locations have been replaced by other crops. At present by far the greatest acreage of French prunes is located on the Yolo, Pleasanton and Pinole series of soils. This crop occupies 60 per cent of the total acreage of the Yolo, 54 per cent of the Pleasanton and about 43 per cent of the Pinole series of soils.

A comparison on the basis of the percentage of the planted area of the different soils (figure 4) shows that the three most extensive soil types have the following relationship: French prunes constitute 76 per cent of the planted area of the Yolo silt loam, 66 per cent of the Pleasanton gravelly loam and 60 per cent of the Pinole silt loam. This decreasing proportion is also found to occur in a comparison of the three sub-groups of soil in which these types are placed. Sub-group no. 1 has 71 per cent of its planted area in French prunes, sub-group no. 4 has 66 per cent and sub-group no. 5 is the lowest with 57 per cent of its planted area so utilized. A greater significance is given to these relative plantings if they be considered in conjunction with those for the Sugar prune which follow.

The Sugar Prune.—Among the orchard crops, the Sugar prune ranks next to the French prune in extent of planting, occurring on 1857.1 acres of the Gilroy region. Although this represents only slightly more than 10 per cent of the acreage occupied by the French variety, its importance lies in the relatively extensive planting on the soils of the Pinole series.* Cultural methods are similar to those for the French prune, with the exception of pruning. The Sugar prune is more heavily pruned than the French under similar circumstances. This practice is most extreme in those orchards located on the deep, friable soils of the Yolo and Vina series where the Sugar prune is cut back in the severe manner typically used with the apricot.

The Sugar prune was introduced by Luther Burbank at the close of the last century in an attempt to develop a prune having a larger size with the excellent qualities of the French variety. This later introduction has been the chief reason for the relatively smaller acreage planted to this variety as compared to the French prune. Apparently due to a greater capability to endure adverse conditions and to a more vigorous habit of growth, the Sugar prune is better

* Investigation of numerous references to the "Sugar prune soils" of this region has shown that the Pinole series of soils have been so-named locally; indicating that the local growers have found a significant relationship between these soils and the Sugar prune.

able to withstand the limiting effects of the heavy and impervious subsoils of the Pinole and related series than is the French prune. In fact, most orchardists consider the Sugar prune to be more satisfactory on these soils than they are on the deep, friable soils of the Yolo and Vina series.

The Sugar prune is most extensively planted on the Pinole silt loam, occurring on 665.9 acres of this type (approximately 35 per cent of the total area devoted to this crop), as compared with 347.7 acres on the Pleasanton gravelly loam and 77.3 acres on the Yolo silt loam.

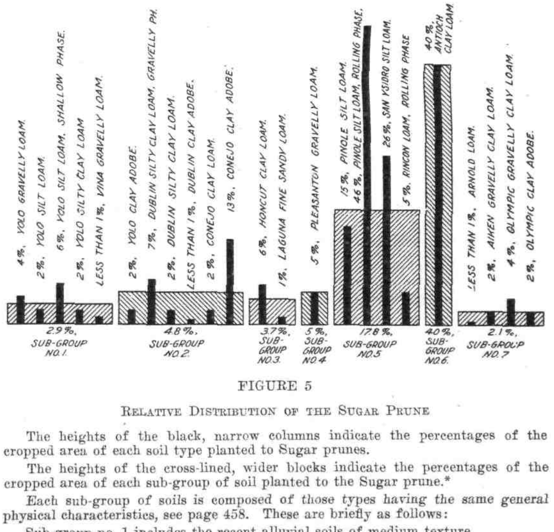

FIGURE 5

RELATIVE DISTRIBUTION OF THE SUGAR PRUNE

The heights of the black, narrow columns indicate the percentages of the cropped area of each soil type planted to Sugar prunes.

The heights of the cross-lined, wider blocks indicate the percentages of the cropped area of each sub-group of soil planted to the Sugar prune.*

Each sub-group of soils is composed of those types having the same general physical characteristics, see page 458. These are briefly as follows:

Sub-group no. 1 includes the recent alluvial soils of medium texture.
Sub-group no. 2 includes the recent alluvial soils of heavy texture.
Sub-group no. 3 includes the recent alluvial soils with heavy subsoils.
Sub-group no. 4 includes the old transported soils with permeable subsoils.
Sub-group no. 5 includes the old transported soils with impervious subsoils.
Sub-group no. 6 includes the old transported soils with calcareous subsoils.
Sub-group no. 7 includes the residual soils.

* See footnote p. 463.

On a basis of the percentage of planted area (figure 5), the three most extensive soil types show the following relationship: 2.0 per cent of the crops planted on the Yolo silt loam and 5.0 per cent of the planted area of the Pleasanton gravelly loam are Sugar prunes, as compared to 15.0 per cent in the case of the Pinole silt loam. A comparison of the sub-groups of soils containing these three types shows a similar trend; sub-group no. 1 has less than 3.0 per cent of its planted area in Sugar prunes, sub-group no. 4 has 5.0 per cent, and sub-group no. 5 has nearly 18.0 per cent.

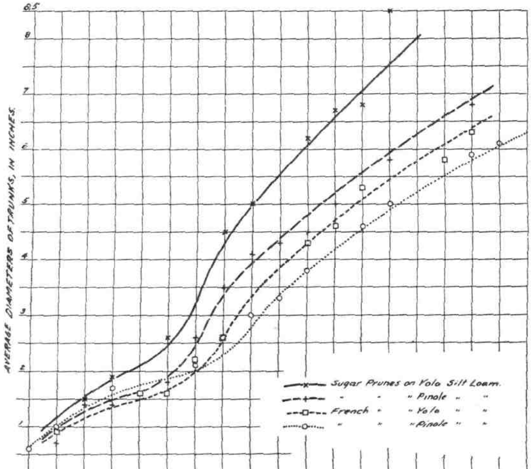

Fig. 6. Curves of average trunk diameters for French and Sugar prune trees of various ages growing on the Yolo and Pinole silt loams.

These figures show a distinct contrast in the relative distribution of these two varieties of prunes, particularly in the case of the Yolo and Pinole silt loams.

Growth Measurements of French and Sugar Prunes.—The successful production of French and Sugar prunes on the Pinole and Yolo silt loams being apparently associated with differences in habits of growth and vigor, four hundred trees of these two varieties growing

on both soils were measured to determine: (1) rate of increase of trunk diameters, and (2) average length of shoot growth at different ages.

The average diameters of the trunks of these two prune varieties were found for trees of various ages on the two soils and curves were constructed of the rate of increase (figure 6). On the basis of these curves, each of the varieties made a more rapid growth on the Yolo

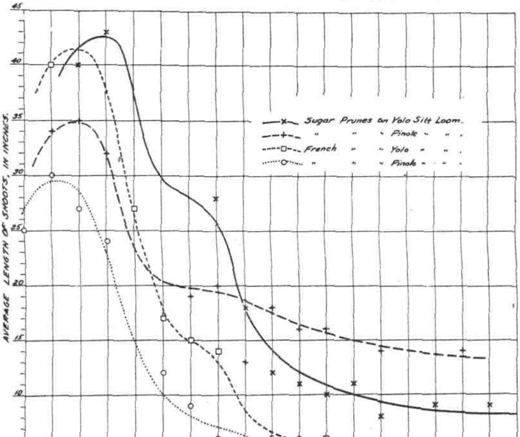

Fig. 7. Curves of average shoot-growth for French and Sugar prune trees of various ages growing on the Yolo and Pinole silt loams.

silt loam than they did on the Pinole silt loam. The trunk measurement of the ten-year old Sugar prune trees on the Yolo silt loam is one and one-half times that of the French prune on the same soil and nearly twice the size of that variety when grown on the Pinole silt loam. Further, the diameters of the bearing Sugar prunes (eight years and older) on the Pinole silt loam average about one-half inch larger than do those of the French prunes of similar age on the Yolo silt loam, ordinarily considered a better orchard soil.

In a discussion of the effects of the severity of pruning on the rate of trunk growth of young fruit trees, one investigator* states that the severe pruning of young trees results in a smaller diameter increase than does light pruning. Applying this conclusion to these two prune varieties, the increased size of the Sugar prune trunks may be ascribed to a greater inherent vigor of growth and not to pruning practices, as the Sugar prune is pruned more heavily than the French, particularly when grown on such soils as the Yolo silt loam.

Curves also were constructed of the average lengths of shoot growth for trees of various ages of these varieties growing on both soil types. (Figure 7.)

From these measurements it may be concluded that the sugar prune has a greater inherent vigor of growth than the French prune and that either variety makes a more extensive growth on the Yolo silt loam than on the Pinole silt loam. A striking difference is shown in the length of growth made by the bearing Sugar prunes on the Pinole silt loam as compared to that made by the French variety on the same soil (figure 8). These figures, supplemented by numerous field observations, indicate that the most desirable and profitable growth of these two prunes occurs when the French prune is planted on the Yolo silt loam and the more vigorous growing Sugar prune is located on the Pinole silt loam.

The Grape.—The grape is the second most extensively planted crop in the Gilroy Region, occupying 4410.9 acres, comprising about 16 per cent of the total planted area. This is about one-quarter the extent of the French prune acreage and more than twice that of the Sugar prune.

With the sole exception of one very small planting of Thompson Seedless near San Martin, the grape plantings are all of the wine varieties. Despite the uncertain future for this crop, few vineyards have been replaced by other crops in recent years, and a normal proportion of the present acreage consists of new plantings. Under ordinary circumstances the greater part of the vineyards are not irrigated, but during the dry season of 1924 more than half of the acreage received one or more applications of water. The growers have found the grape to be better suited to the old transported soils than to the deep soils of recent alluvial formation. On the latter soils the vines make a very heavy vegetative growth which undesirably shades the fruit, adds to the labor of harvest, and seldom results in an increased yield, while the quality of the juice is generally poorer.

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* W. P. Tufts. Univ. California Agr. Exp. Sta. Bull. 313:111–153. 1919.

The grape is most extensively planted on the Pleasanton gravelly loam, 1703.2 acres being so utilized, while the Pinole silt loam ranks second with 1261.6 acres and the Yolo silt loam third with 339.5 acres.

Fig. 8.—Ten year old orchard east of Gilroy showing difference in length of shoot growth between French (tree No. 2) and Sugar (tree No. 1) prunes on Yolo silt loam. Length of 1925 growth shown between outstretched hands of the two men in lower photo.

On the basis of percentage of the planted area of the soil types (figure 9), the Pleasanton gravelly loam and the Pinole silt loam show similar relations, with the grape comprising 28 and 29 per cent of the cropped acreage of these soils. With a single exception, the Laguna loam, the recent alluvial soils have a considerably lower proportion planted to grapes. The Laguna loam, like a few other soil types which

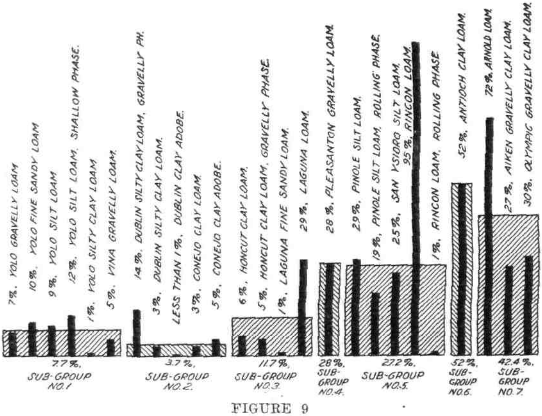

FIGURE 9

RELATIVE DISTRIBUTION OF THE GRAPE

The heights of the black, narrow columns indicate the percentages of the cropped area of each soil type planted to grapes.

The heights of the cross-lined, wider blocks indicate the percentages of the cropped area of each sub-group of soil planted to the grape.*

Each sub-group of soils is composed of those types having the same general physical characteristics, see page 458. These are briefly as follows:

Sub-group no. 1 includes the recent alluvial soils of medium texture.
Sub-group no. 2 includes the recent alluvial soils of heavy texture.
Sub-group no. 3 includes the recent alluvial soils with heavy subsoils.
Sub-group no. 4 includes the old transported soils with permeable subsoils.
Sub-group no. 5 includes the old transported soils with impervious subsoils.
Sub-group no. 6 includes the old transported soils with calcareous subsoils.
Sub-group no. 7 includes the residual soils.

show conspicuously large percentages planted to the grape, is of limited significance due to the minor area involved. A corresponding relation is shown by the three principal sub-groups of soils; sub-group no. 1 has 7.7 per cent of its planted area in grapes, sub-group no. 4 has 28.0 per cent and sub-group no. 5 has 27.2 per cent so utilized.

* See footnote p. 463.

The correlation of this crop with the Pleasanton gravelly loam and the Pinole silt loam is in accord with the observations of the various growers as to the most profitable and desirable soil situation for the grape.

The Pear.—The pear (with a total acreage of only 409.1 acres) shows a significant distribution. Although grown on a number of

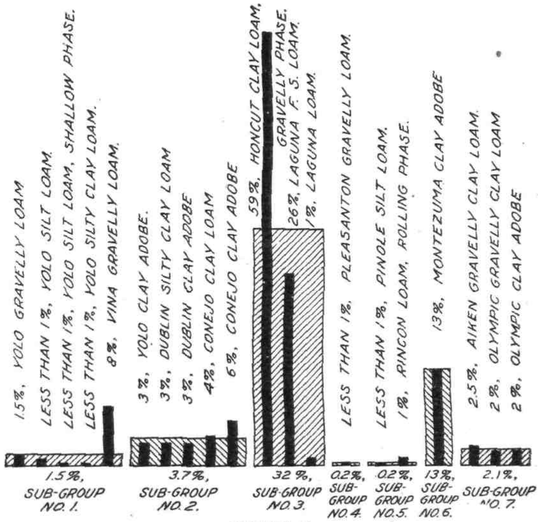

FIGURE 10

RELATIVE DISTRIBUTION OF THE PEAR

The heights of the black, narrow columns indicate the percentages of the cropped area of each soil type planted to pears.

The heights of the cross-lined, wider blocks indicate the percentages of the cropped area of each sub-group of soil planted to pears.*

Each sub-group of soils is composed of those types having the same general physical characteristics, see page 458. These are briefly as follows:

Sub-group no. 1 includes the recent alluvial soils of medium texture.
Sub-group no. 2 includes the recent alluvial soils of heavy texture.
Sub-group no. 3 includes the recent alluvial soils with heavy subsoils.
Sub-group no. 4 includes the old transported soils with permeable subsoils.
Sub-group no. 5 includes the old transported soils with impervious subsoils.
Sub-group no. 6 includes the old transported soils with calcareous subsoils.
Sub-group no. 7 includes the residual soils.

* See *footnote* p. 463.

soils in the Gilroy Region, this crop has been planted mainly on the heavier-textured recent alluvial soils included in the second and third sub-groups.

The Bartlett is the chief variety. The Japanese pear is used as the principal root-stock in all but the oldest plantings. Cultural methods are simple and practically all of the orchards are irrigated.

More than 90 per cent of the acreage planted to pears is on the recent alluvial soils, particularly those of the second and third sub-groups. The most extensive planting of this fruit (70.3 acres) is on the Conejo clay adobe, with slightly lesser acreages on the Laguna fine sandy loam and gravelly phase of the Honcut clay loam. The three most extensive soil types, Yolo silt loam, Pleasanton gravelly loam, and Pinole silt loam have only very minor acreages planted to this crop.

On the basis of the percentage of the planted area of the soil types (figure 10), the gravelly phase of the Honcut clay loam has 59 per cent planted to pears, the Laguna fine sandy loam has 26 per cent, Vina gravelly loam has 8 per cent, and then next occur* the five soil types included in sub-group no. 2. A comparison of the soil sub-groups indicates a similar relationship; sub-group no. 1 has 1.5 per cent (102.0 acres) of its planted area in pears, sub-group no. 2 has 3.7 per cent (173.0 acres), and sub-group no. 3 has 32 per cent (102.0 acres) planted to this fruit.

This correlation of the pear plantings and the heavy-textured recent alluvial soils is in accord with the opinions of growers, who have found that the pear is the most profitable orchard crop in the region for these soils. It is difficult to account for the relatively small percentage shown by sub-group no. 2, as compared to that of sub-group no. 3, except on an economic basis; only a very limited number of the crops of the region appear to grow well on the Honcut and Laguna soils although the second sub-group is particularly adapted to the production of seed and truck crops (see later) as well as being suited to a number of other crops grown in this region.

Truck and Seed Crops.—The production of vegetable seeds is one of the unique and important agricultural activities of the Gilroy Region. The Santa Clara Valley is estimated to furnish 95 per cent of the lettuce seed, nearly all of the radish seed, and about 75 per cent of the onion seed produced in the United States. All of the factors that are involved in making this section one of the ideal spots

* In this consideration the Montezuma clay adobe has been ignored, despite its 13 per cent, as the acreage involved is extremely small.

for the production of these highly specialized crops can not be successfully determined, although the absence of wind and rain during the growing season is one of the most important causes. Within the district, however, the distribution of the seed crops is definitely associated with the occurrences of distinct soil characteristics. The nature of this crop being such that irrigation is very undesirable, the growers have limited their plantings to the heavier types of the Yolo and Dublin series of soils, the highest in water-holding capacity and among the most fertile in the Gilroy Region.

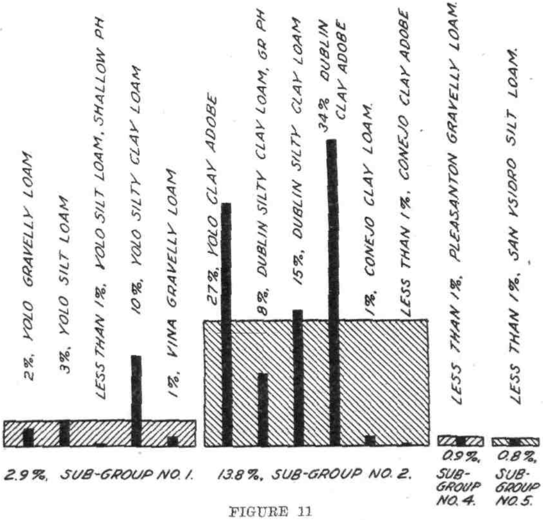

FIGURE 11

RELATIVE DISTRIBUTION OF TRUCK OR SEED CROPS

The heights of the black, narrow columns indicate the percentages of the cropped area of each soil type planted to truck or seeds.

The heights of the cross-lined, wider blocks indicate the percentages of the cropped area of each sub-group *of soil planted to truck or seeds.**

Each sub-group of soils is composed of those types having the same general physical characteristics, see page 458. These are briefly as follows:

Sub-group no. 1 includes the recent alluvial soils of medium texture.

Sub-group no. 2 includes the recent alluvial soils of heavy texture.

Sub-group no. 4 includes the old transported soils with permeable subsoils.

Sub-group no. 5 includes the old transported soils with impervious subsoils.

* See footnote p. 463.

Limited acreages of vegetables for market purposes are grown in this region, but at the time the crop survey was made it was impossible to determine whether the crop was destined for market as fresh vegetables or as seed, in some cases the owner himself had not made a decision. For this reason the vegetable plantings were included with the seed crops under the common heading of "Truck and Seed Crops."

Lettuce and onion seed have been found to produce best on the clay adobe and silty clay loam of the Dublin and Yolo series, while the radish yields best on the slightly lighter-textured soils, such as the Yolo silty clay loam and silt loam.

The most extensive acreage of truck and seed crops is on the Dublin clay adobe, 331.3 acres (nearly one-third of the total acreage of the crop) occurring on this type. The next important plantings are the 236.4 acres on the Dublin silty clay loam and the 169.6 acres on the Yolo silty clay loam.

Comparing the distribution of this crop on the basis of the percentage of planted area of each soil type (figure 11), the Dublin clay adobe is again seen to be the most important, with 34 per cent of its planted area so utilized, followed in order by the Yolo clay adobe, with 27 per cent; the Dublin silty clay loam, with 15 per cent; and the Yolo silty clay loam, with 10 per cent. On the basis of a percentage of the planted areas of the sub-groups a similar relationship is shown; sub-group no. 2 has 13.8 per cent of its planted area utilized for the production of truck and seed crops as compared to 2.9 per cent of sub-group no. 1 and less than 1.0 per cent in the case of sub-groups no. 3 and no. 4.

The foregoing correlations indicate that the truck and seed crops in the Gilroy Region are grown almost exclusively on the recent alluvial soils of heavy texture, which are most economically suited to their production.

Alfalfa.—Alfalfa is of extensive occurrence in this region, with an aggregate extent of 1048.3 acres. The distribution of this crop is of minor significance as a large portion of the total acreage occurs in small plantings; many of the orchardists use it as a ground cover in their fruit-drying yards. A few large fields have been planted commercially in the central and southern portion of the Gilroy Region and these occur most extensively on the recent alluvial soils of the Yolo and Dublin series.

The Apricot.—The apricot is one of the extensively planted crops of the region, having a total extent of 1402.0 acres. However, its

distribution is also of limited significance as frost hazard, rather than soil suitability, is frequently the determinant factor. The greater acreage of the mature trees are located on the level floor of the valley, south of Coyote, where the earliest orchard development occurred. Many of the earlier plantings of apricots in that locality have been replaced by orchards of French prunes. The greatest number of young apricot orchards, as well as the largest acreage, is situated on the upper portions of the alluvial fans and terraces on the eastern side of the valley where the air drainage is better and frost damage lessened. The apricot is most extensively planted on the Yolo series (470.0 acres), with lesser acreages on the Pinole (about 300 acres) and Pleasanton series (about 200 acres).

The Peach.—The peach is a crop of minor importance in the Gilroy Region, having an extent of 628.7 acres. A much larger acreage of this fruit was planted here formerly, but a large part of its acreage has been replanted to prunes and other more profitable crops. At present only 20.5 acres of non-bearing peaches occur in this region, a fair indication of the amount of interest which the growers are giving this crop.

The lighter-textured, more gravelly soils are said to produce the best peach for drying purposes, while the medium-textured alluvial soils produce a better canning fruit. More than 50 per cent of the peaches (328.9 acres) occur on the Pleasanton gravelly loam, nearly 20 per cent (113.9 acres) are on the Yolo silt loam, and about 15 per cent (101.9 acres) on the Pinole silt loam.

The Walnut.—The walnut is a more extensively planted crop in the region than is apparent to the casual observer. In addition to a large number of trees planted in borders, or individually, there are 641.5 acres planted in groves. By far the greater portion of these occur interplanted in orchards, only 99.8 acres being pure groves of walnuts.

Although the walnut has been found to be most profitable on the deep, fertile, recent alluvial soils, there are extensive plantings on the old transported soils of the valley floor. This has been done not through any belief that these soils are best suited to the walnut but as an attempt to avoid the disastrous effects of the oak root fungus which attacks the prune and similar trees.

The plantings of walnuts on the Pleasanton gravelly loam (207.1 acres) is the most extensive, but the distribution of this crop is of only minor importance in this study, as in many of the plantings the factor of soil suitability has been superseded by other considerations.

Tomatoes.—Tomatoes are one of the important "cash" crops interplanted in the young orchards. Of the 711.7 acres of tomatoes planted on the soils of the region, nearly four hundred acres are pure plantings and 253.1 acres are in young orchards of prunes, pears and figs.

The mixed plantings have little significance in these studies, as the orchard is generally the more important from the grower's point of view. A greater significance lies in the distribution of the pure plantings of this crop; the most extensive occurrences being on 111.0 acres of the Dublin silty clay loam, 57.0 acres of the Dublin clay adobe and 48.1 acres of the Yolo silty clay loam. This correlation is in accord with the findings of the growers that the tomato is most profitable on the heavy-textured, fertile, recent alluvial soils.

Sugar Beets.—There are 629.2 acres of sugar beets in the region, all located in the north near Coyote. The importance of these plantings lie in the character of the soils on which they occur; more than 90 per cent of the crop being grown on the bodies of the calcareous phase of the Dublin clay adobe and silty clay loam. The moderate to high content of lime found in these bodies of soil, which is not found in the Dublin clay adobe and silty clay loam in other portions of the region, makes them better suited to the production of the sugar beet.

Minor Miscellaneous Crops.—A number of other crops are being grown in the Gilroy Region, but due to their minor occurrence their distribution is of limited, or no, significance in this study. These include the cherry, apple, fig, almond, strawberries, bushberries, corn and sorghum, as well as very limited acreages of seedling myrobalan, nursery stock, and eucalyptus groves.

CONCLUSIONS

The foregoing data indicate that definite correlations exist between the various types of soil and the crops occurring in the Gilroy Region and that the distribution of the major crops has been determined by soil variation. These correlations have resulted from "trial and error" methods of planting during a relatively long period of agricultural development.

A direct comparison on an acreage basis is unsatisfactory, as variation occurs in the crop acreages and in the extent of the different soil types. A more significant relationship, one in which due weight is given to the less extensive occurrences, is shown by the percentages of the total planted area of each soil occupied by the various crops.

The French prune, the most extensively planted crop in the Gilroy Region, occurs on 76 per cent of the planted area of the Yolo silt loam, 66 per cent of the Pleasanton gravelly loam, and 60 per cent of the Pinole silt loam. The significance of these figures is in the relative order of their occurrence on these three most important soil types and not in the comparative narrow range of percentages.

In the case of the Sugar prune this order is reversed. The Sugar prune occupies only 2 per cent of the planted area of the Yolo silt loam and 5 per cent of the Pleasanton gravelly loam as compared to 15 per cent of the Pinole silt loam. Measurements of shoot growth and trunk diameters, as indices of relative vigor, support the conclusions of the growers that the Sugar prune is better suited to the Pinole silt loam and that the French variety is better suited to the Yolo silt loam.

The grape, the second most extensive crop, has been found to be more satisfactory on the old transported soils than on the deep, fertile, recent alluvial soils. These data show that the distribution of the grape in this region reflects this relationship as the crop occupies only 9 per cent of the planted area of the Yolo silt loam, although it occupies 28 per cent of the planted area of the Pleasanton gravelly loam and 29 per cent of the Pinole silt loam.

The other crops of the region, although of smaller extent, also are distributed predominantly on those soil types to which they are best suited. The pear occurs mainly on the heavy-textured recent alluvial soils, particularly those of the Laguna series. The apricot, probably the only crop of the region whose distribution has been affected more or less by climatic conditions, is planted most extensively

on the soils of the Yolo series. Truck and seed crops are planted almost exclusively on the heavy types of the Yolo and Dublin soils, the highest in water-holding capacity and among the most fertile of the region. The pure plantings of tomatoes likewise occur predominantly on these soils. The sugar beet, although of limited extent, is practically confined to the calcareous phases of the heavy-textured Dublin soils. The other minor crops of the region show more or less correlation with the soil types, but are of doubtful significance due to their limited acreages.

This study is an evaluation of the effect of the soil type as shown by the distribution of the varieties of cultivated plants grown upon these types. It gives the combined results of a great number of environmental features, physical, chemical and biological, embodied within the zone occupied by the plant roots, without attempting to segregate any particular feature of soil difference which might influence this distribution. It evaluates the sum of all of these influences by measuring the crop distribution in a region where cropping has been continued for a long enough time so that through repeated failures or successes the cultivated crops have migrated to the soils which seem to provide most satisfactory conditions for their profitable production. In this it is comparable to a study of the natural distribution of plants in a virgin country.

As a result of these studies it appears proper to conclude that, *in a district such as the Gilroy Region the proportion of each crop on each soil is a measure of the relative suitability of that crop for that soil.*

An extension of these studies to other districts would determine the degree of suitability existing between standard crops and the other extensive soil types. This information would be an important guide in the determination of what crops should be recommended for the soils in regions where development is still in an early stage.